2000 ATLANTIC SWORDFISH – EXECUTIVE SUMMARY

No new Atlantic stock assessments were conducted in 2000. This report updates the Description of Fisheries, Current Regulations, and comments briefly on new information for 2000 in the Status of Stocks, Outlook, and Management Recommendations sections. Most of the report and the conclusions of the Committee, remain unchanged from the 1999 Report. For the purposes of this Executive Summary, catches that were not reported were assumed to be equal to the reports for the previous year. In 1999, this was a small amount in the North, but over 6% in the South (see **SWO-ATL-Table 1**).

SWO-ATL-1. Biology

Swordfish are distributed widely in the Atlantic Ocean and Mediterranean Sea, and range from Canada to Argentina on the western side, and from Norway to South Africa on the eastern side **(SWO-Figure 1)**. The management units for assessment purposes are a separate Mediterranean group, and North and South Atlantic groups separated at 5ºN. This stock separation is supported by recent genetic analyses. However, the precise boundaries between stocks are uncertain, and mixing is expected to be highest at the boundary in the tropical zone. Therefore there is uncertainty as to whether the management units used correspond exactly to the biological stock units. Hence, it is important to have effective management measures throughout the Atlantic and Mediterranean.

Swordfish feed on a wide variety of prey including groundfish, pelagics, deep-water fish and invertebrates. They are believed to feed throughout the water column, following the diel migration of the deep-scattering layer by maintaining their position within a preferred level of illumination (isolume). They are typically caught on pelagic longlines at night when they feed in surface waters.

Swordfish spawn in the warm tropical and subtropical waters throughout the year, although seasonality has been reported. They are found in the colder northern waters during summer months. Young swordfish grow very rapidly, reaching about 140 cm LJFL (lower jaw-fork length) by age 3, but grow slowly thereafter. Females grow faster than males and reach a larger maximum size. Swordfish are difficult to age, but 53% of females are considered mature by age 5, at a length of about 180 cm.

SWO-ATL-2. Description of fisheries

Directed longline fisheries in EC-Spain, the United States and Canada have operated since the late 1950s or early 1960s, and harpoon fisheries have existed since the late 1800s. The Japanese tuna longline fishery started in 1956 and has operated throughout the Atlantic since then, with substantial catches of swordfish that are produced as a by-catch in their tuna fisheries. There are other primarily directed swordfish fisheries (i.e., Brazil, Morocco, Namibia, EC-Portugal, South Africa, Uruguay, and Venezuela,) and by-catch or opportunistic fisheries which take swordfish (i.e. Chinese Taipei, Korea, EC-France and Brazil). The SCRS scientists believe that ICCAT Task I landings data provide minimum estimates because of unreported catch of swordfish made in association with illegal, unreported and unregulated (IUU) fishing activities. However, because trade data are lacking or incomplete for estimating IUU swordfish catch, the amount of NEI swordfish catch by IUU vessels could not be estimated.

Total: The total Atlantic estimated catch of swordfish (North and South, including discards) reached an historical high of 38,609 MT in 1995, 13% higher than the previous peak catch of 34,175 MT in 1989 **(SWO-Table 1** and **SWO-Figure 2**). The 1999 estimated catch (reported and carried over) was 27,377 MT. As a few countries have not yet reported their 1999 catches and because of unknown IUU catches, this value should be considered provisional and subject to revision.

North: From 1989 to 1999, the North Atlantic estimated catch (landings plus discards) has averaged about 15,000 MT **(SWO-Table 1** and **SWO-Figure 2)**, although the 1999 landings plus discards were reduced to 11,914 MT in response to ICCAT regulatory recommendations. In 1999, EC-Spain and the U.S. have decreased their peak North Atlantic landings, by 64% since 1987 and by 55% since 1989, respectively, in response to ICCAT recommendations. If the U.S. discards are counted, the total U.S. landings and discards have declined by 47% from the peak catch level of 1989. Reduced landings have also been attributed to shifts in fleet distributions, including movement of some vessels to the South Atlantic and out of the Atlantic. In addition, some fleets, including the United States, EC-Spain, EC-Portugal and Canada, have changed operating procedures to opportunistically target tuna and/or sharks, taking advantage of market conditions and higher

relative catch rates.

South: The South Atlantic estimated catch (landings plus discards) was relatively low (generally less than 5,000 MT) before 1980. Since then, landings have increased continuously through the 1980s and 1990s to a peak of 21,887 MT in 1995 (levels that match the peak of North Atlantic harvest). The increase of landings was in part due to progressive shifts of fishing effort to the South Atlantic, primarily from the North Atlantic, as well as other waters. Then the estimated landings decreased to 13,526 MT by 1998 (38% reduction). The reduction in catch following the peak in 1995 was in response to the regulations, and was partly due to a shift to other oceans and to a shift in target species. In 1999, the estimated landings increased 14% from 1998 levels and attained 15,463 MT. Brazil, People's Republic of China and Namibia, in particular, contributed to this increase.

Discards: Only U.S. (1991-1999) and Canada (1997-1999) report positive estimates of dead discards. EC-Spain reports zero dead discards. Both the U.S. and Canada used scientific observer data to estimate dead discards. The Canadian estimate sets the proportion of the weight of dead discards to reported landings equal to the proportion of dead discards observed compared to observed landings. However based on the information from national scientists the Committee is concerned about the representativeness of the Canadian sampling. The U.S. used CPUEs from the observer data and effort from the captain reported logbook data to estimate dead discards. These estimates are included in the stock assessment evaluation and in forward population projections.

SWO-ATL-3. State of stocks

In 2000, some of the updated North and South Atlantic CPUE data were available and were examined. The time series show similar trends to those in recent years. The available series for the North stock continue to show signs of optimism as observed in 1999, and the one series examined for the South is stable over the time series.

In 1999, a new assessment of North and South Atlantic swordfish stocks was conducted. In the assessment, updated CPUE and catch data were examined. Sex and age-specific (North Atlantic) and biomass standardized catch rates (North and South Atlantic) from the various fleets were updated. The updated North Atlantic CPUE data show similar trends to previous years, but are also showing signs of stabilization or some improvement in the last few years. In particular, the recruitment index (1997 and 1998) and the catch at age (1997) used in the 1999 North Atlantic assessment show signs of substantially improved recruitment (age 1). The updated recruitment index also showed a high value in 1999. These recent improvements in recruitment have already manifested in younger ages and in the biomass index of some fisheries, and should allow for increases in spawning biomass in the future (2001 and thereafter) and a more optimistic outlook, if the recent year-classes are not heavily harvested. The CPUE patterns in the South Atlantic by fleet are assumed to reflect the abundance pattern of different age groups of the population.

North: In 1999, the status of the North Atlantic swordfish resource was assessed using both non-equilibrium stock production models and sex-specific sequential population analyses (SPA) based on catch **(SWO-Table 1)** and CPUE data through 1998. The relationship between catches and standardized fishing effort is shown in **SWO-Figure 3**. The current base case assessments indicate that the decline in the North Atlantic swordfish biomass appears to have been slowed or arrested due to recent reductions in reported catch, especially compared to the peak catch values of 1987 **(SWO-Figure 4)**. In addition, estimated high recruitment (age1) in 1997 and 1998 could promote improvement in future spawning stock biomass, if these year classes are not heavily harvested. The pattern of decline in stock size followed by recent stabilization is reflected in the CPUEs for several fisheries, although variability in CPUEs leads to uncertainty about the degree of change in recent years. An updated estimate of maximum sustainable yield from production model analyses is 13,400 MT (with estimates ranging from 7,600 to 15,900 MT). Since 1983, only in four years (1984, 1997, 1998 and 1999) have North Atlantic swordfish catches been less than 13,400 MT **(SWO-Figure 5a)**; preliminary estimates of catches in 1999 were about 11,900 MT.

The biomass at the beginning of 1999 was estimated to be 65% (range: 51 to 105%) of the biomass needed to produce MSY. The 1998 fishing mortality rate was estimated to be 1.34 times the fishing mortality rate at MSY (range: 0.84 to 2.05). The replacement yield for the year 2000 was estimated to be about 11,700 MT. At the 1999 assessment meeting, anticipated catches in 1999 were expected to be about this level given the recent fishery performance and current regulations (i.e. about 10% over the ICCAT recommended catch levels for 1997 and 1998). This prediction has been confirmed in 2000; catches in 1999 were about 11,900 MT **(SWO-Table 1)**. Catches below replacement level are likely to allow the stock to recover.

Overall, the sex-specific sequential population analyses conducted for North Atlantic swordfish in 1999 were consistent with the stock production model results, particularly in terms of the trends in population trajectories. The Base Case sex-specific SPA point estimates for age 1 gradually increased in the early 1980's, shifting to a somewhat higher level from 1985 to 1989. Subsequently, the abundance of age 1 shifted back to a lower level between 1990 and 1996 and then

increased to the highest levels of the time series in 1997 and 1998. The trends for ages 2, 3 and 4 are similar with the appropriate time lags, but the pattern is less pronounced. The estimated abundance of older (5+) fish declined to about one third of the numbers in 1978. The estimated fishing mortality rate has generally increased for all ages. The fishing mortality rate during the last three years was about 0.25 /year for males (age 5+) and 0.57 for females (age 9+). Given this fishing mortality pattern, the biomass of adult females would be reduced to a level of about 8 percent of the maximum at equilibrium. This is well below the level which is commonly considered to result in risks of recruitment over-fishing in other stocks.

South: The Committee noted that catches have been reduced since 1995, as was recommended by the SCRS. Previous Committees expressed serious concern about the trends in stock biomass of South Atlantic swordfish based on the pattern of rapid increases in catch which could result in rapid stock depletion, and declining CPUE trends of some by-catch fisheries. The Committee has had uncertainties about the CPUE series and their relationship to the abundance of the stock. However, the by-catch index was used in the last assessment as it provided a long enough time series required for fitting a production model; CPUE series from target fisheries are only available for a relatively short time period. Some sources of bias were detected in 2000 in the methodological protocol to obtain catch in weight from a by-catch fleet. Additional methodological analyses presented to the Committee indicated some potential sources of bias which could affect any of the series considered.

A quantitative assessment for the South Atlantic swordfish stock was conducted in 1999 based on the available information at that time, yielding results with greater uncertainty than for the North**(SWO-Figure 6)**. In this non-equilibrium production model evaluation, the estimate of maximum sustainable yield was 13,650 MT (with estimates ranging from 5,000 to 19,600 MT). Biomass at the beginning of 1999 was estimated to be 110% (range: 84 to 140%) of the biomass needed to produce MSY. The 1998 fishing mortality rate was estimated to be 0.84 times the fishing mortality rate at MSY (range: 0.47 to 2.54). The surplus production (estimated replacement yield) for the year 2000 was estimated to be about 14,800 MT. Prior to 1989, South Atlantic catches were below the estimated MSY, but since 1991, only in the year 1998 (13,516 MT) have reported South Atlantic swordfish catches been less than 13,600 MT **(SWO-Figure 5b)**. Estimated catches in 1999 of 15,463 MT were below the average from 1991 to 1997 (17,400 MT).

SWO-ATL-4. Outlook

North: For the North Atlantic swordfish stock, the baseline surplus production model showed that, although the decline in swordfish biomass has been slowed or arrested , the population biomass is estimated to be 35% below the level that would produce the maximum sustainable yield. If total catch, including discards and overages, was less than the status quo catch limit of 10,700 MT, there would be a greater than 50% chance that the population would reach B_{MSY} in 15 years, and be approaching B_{MSY} in 10 years. However, 11,800 MT would cause the median population trajectory to continue declining **(SWO-Figure 4)**.

Of the sensitivity analyses performed with other production model formulations and methods for characterizing uncertainty, some were more and some were less optimistic than the baseline model, but all showed that the population was below B_{MSY}. SPA assessments also showed that the female spawning stock biomass was low with respect to common reference points, but the catch levels necessary to rebuild within 5, 10 or 15 years depended on both the management objectives (proxy for B_{MSY}) and the assumptions made, including future recruitment levels, which are influenced by environmental conditions.

The high recruitment observed in recent years (age 1 in 1997, 1998 and 1999) should allow for a more optimistic outlook, if the recent year-classes are not heavily harvested. The updated indices examined in 2000 confirmed that a positive effect of this strong recruitment has already manifested in younger ages and in the biomass indices of several fisheries.

South: The updated CPUE data presented in 2000 from a targeting fishery covering a very large geographical area indicates that the standardized CPUE in 1999 was slightly higher than in recent years, with a flat trend over the available time series. CPUE updates from the other fisheries were not available to examine in 2000.

Based on the 1999 Base Case assessment for South Atlantic swordfish, the recent biomass has declined to around 10% above the MSY level, and that F was around F_{MSY}. If the catch of 1998 (~13,500 MT) is continued into the future, the median trajectory was expected to increase slightly **(SWO-Figure 6)**. However, if total catch in the future is around the current catch limit (14,620 MT), the median trajectory was expected to decline slightly below B_{MSY}. Of the various sensitivity analysis done in 1999, some were more and some were less optimistic. The age structured production model sensitivity analyses were much more pessimistic. The status of the South stock was considered more uncertain than the status of the North stock, due to the limitations of the indices of abundance, and the absence of age and growth data.

SWO-ATL-5. Current regulations

For the purposes of this Executive Summary, catches that were not reported were assumed to be equal to the reports for the previous year. Further, the minimum size evaluation of the level of compliance of fisheries is affected by the amount and criteria used for substitution procedures both between and within fisheries; the lack of catch-at-size data is more pronounced in the South Atlantic. For these reasons, caution should be exercised using scientific estimates for compliance purposes.

North catch limits: The total allowable catch in the North Atlantic in 1999 was 10,700 MT. Estimated landings exceeded this by 6% (11,385 MT) and reported landings plus discards exceeded this by 11% (11,914 MT).

South catch limits: The catch limit in the South Atlantic in 1999 was 14,620 MT. Estimated landings exceeded this by 6% (15,457 MT) and reported landings plus discards exceeded this also by 6% (15,463 MT).

Minimum size limits: In 1998, the percentage of swordfish reported landed less than 125 cm LJFL was about 19% (by number) overall for all nations fishing in the Atlantic. If this calculation is made using reported landings plus discards then the percentage less than 125 cm LJFL was about 23%. These calculations were not updated and examined in 2000.

The Committee expressed concern about the uncertainty of the stock structure of Atlantic swordfish and the possibility that the assumed North Atlantic stock does not include the entire catch from the biological stock. When boundaries are uncertain, in this case because of limited or imprecise data, it is important to implement appropriate measures which encompass several possible stock assumptions.

SWO-ATL-6. Management recommendations

No new assessment was developed in 2000, so the recommendations are mainly based on the results obtained in 1999 and updated with some new information provided to the SCRS in 2000.

North Atlantic

In the last assessment, the Committee indicated that the actions the Commission had taken to reduce catch in 1997 to 1999 appear to have slowed and/or arrested the decline in the North Atlantic swordfish stock. At that time, the Committee recommended to the Commission, if it desires to rebuild the North Atlantic swordfish stock to biomass levels that would support MSY within 10 years with a probability of greater than 50%, then the catch should be reduced to 10,000 MT. At a constant catch of the 1999 catch limit of 10,700 MT, there is a greater than 50% chance of reaching MSY levels in 15 years. However, this recovery probability is very sensitive to even a 10% overage, and if constant catches of 11,800 MT (1999 catch limit plus 10%) are continued for the next 15 years, the stock will likely not reach biomass levels that will support MSY with a probability of greater than 50%. Therefore if the Commission wishes to rebuild in a 15-year time frame, catch limits (including discards) should not be increased, and should not be exceeded. The Committee noted with concern that the 1999 catches were 11,914 MT, about 11% above the TAC. The management actions taken by the Commission in 1997 to 1999 clearly illustrate the resilience of swordfish, and the responsiveness of the stock to a decrease in fishing mortality. With just three years of management action under the strict quota scenario (introduced in 1997), there are positive signs from the fishery in terms of catch rates. However, the Committee noted that positive signs in recent recruitment may be in part due to environmental influence, and it is unknown if this influence will be positive or negative in the future.

The Committee expressed concern about the high catches (landings plus discards) of small swordfish and the lack of and possible inaccuracies of size data from many fisheries, and emphasized that gains in yield could accrue if the intent of current recommendations on small fish could be more effectively implemented. The high recruitment observed in recent years (age 1 in 1997, 1998 and 1999) should allow for a more optimistic outlook if the recent year-classes are not heavily harvested. The updated indices examined in 2000 confirmed that a positive effect of this strong recruitment has already manifested in younger ages and in the biomass indices of several fisheries

South Atlantic

The Committee noted that catches have been reduced from the 1991-1997 average, consistent with the recommendations by the SCRS. The estimated catches in 1999 were 15,463 MT. The SCRS continues to be concerned about the swordfish stock status in the South Atlantic based on the results of preliminary production model analysis conducted in 1999 and on the pattern of high catches and declining CPUE trends in some of the by-catch fisheries used in 1999 as indicators of abundance. The result obtained in 1999 was that the recent level of biomass was estimated to be at about 10%

above the level that would support MSY. However, if there is a constant catch at the year 2000 catch limit (14,620 MT) for the next 10 years, there is a greater than 50% chance of biomass declining to levels slightly below the level that would support MSY. Catches at the level of 1998 (~13,500 MT) would keep the stock at about (and above) the biomass level that would support MSY. The Commission should be reminded that the production model is affected by high levels of uncertainty in the input data. If the Commission intends to increase the probability of keeping the stock in a healthy condition, it should keep fishing mortality rates, and hence catch, at about MSY levels.

ATLANTIC SWORDFISH SUMMARY

	North Atlantic	*South Atlantic*
Maximum Sustainable Yield[1]	13,370 MT (7,625-15,900)[4]	13,650 MT (5,028-19,580)
Current (1999) Yield	11,914 MT	15,463 MT
Current (2000) Replacement Yield[2]	11,720 MT (6,456-15,040)	14,800 MT (5,328-16,240)
Relative Biomass (B_{1999}/B_{MSY})	0.65 (0.51-1.05)	1.10 (0.84-1.40)
Relative Fishing Mortality:		
F_{1998}/F_{MSY}[1]	1.34 (0.84-2.05)	0.81 (0.47-2.54)
F_{1998}/F_{max}[3]	1.60 (1.52-1.68)	Not estimated[5]
$F_{1998}/F_{0.1}$[3]	3.52 (3.44-3.70)	Not estimated
Management Measures in Effect	Country-specific quotas [99-2]; 125/119 cm LJFL minimum size [99-2].	Country-specific quotas [97-7]; 125/119 cm LJFL minimum size [90-2] & [95-10].

1 Base case production model results based on catch data 1950-1998 **(SWO-Table 1 1999 SCRS Report)**.
2 For next fishing year.
3 Base case sex-specific SPA results based on catch data 1978-1998 **(SWO-Table 1 1999 SCRS Report)**; statistics computed based on females only.
4 80% confidence intervals are shown.
5 Production model results do not provide a basis for these estimates.

SWO-ATL-Table 1. Estimated catches(reported and carried over, in MT) of Atlantic swordfish by region, gear, flag.

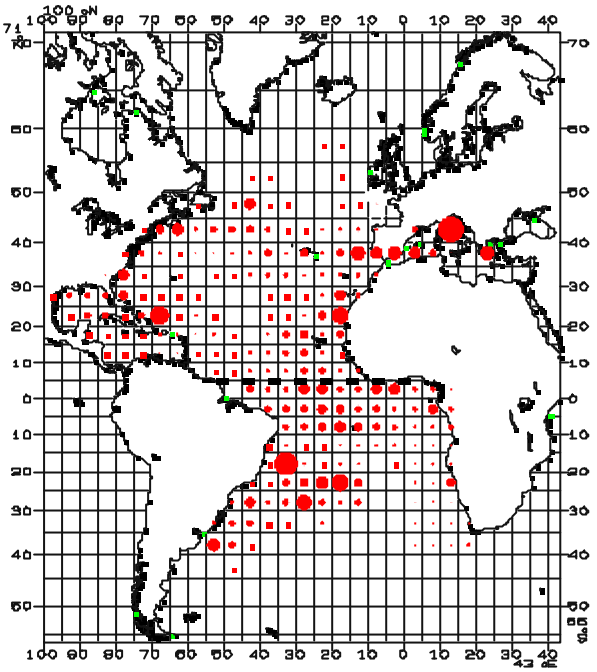
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOT ATL (LAND+DISC)	9264	14601	15231	18881	15155	19662	19929	21930	23969	24380	26266	32470	34175	32886	28815	29195	32890	35112	38609	33180	31483	25788	27377
N. ATL(LAND+DISC)	**6409**	**11835**	**11937**	**13558**	**11180**	**13215**	**14527**	**12791**	**14383**	**18486**	**20236**	**19513**	**17250**	**15672**	**14937**	**15394**	**16845**	**15321**	**16722**	**15052**	**13102**	**12262**	**11914**
LANDINGS	***6409***	***11835***	***11937***	***13558***	***11180***	***13215***	***14527***	***12791***	***14383***	***18486***	***20236***	***19513***	***17250***	***15672***	***14722***	***15011***	***16437***	***14613***	***16196***	***14464***	***12651***	***11777***	***11385***
LONGLINE	*5458*	*11123*	*11177*	*12831*	*10549*	*13019*	*14023*	*12664*	*14240*	*18269*	*20022*	*18927*	*15348*	*14026*	*14208*	*14288*	*15755*	*14129*	*15615*	*13639*	*12261*	*10837*	*10754*
OTHER GEARS	*951*	*712*	*760*	*727*	*631*	*196*	*504*	*127*	*143*	*217*	*214*	*586*	*1902*	*1646*	*514*	*723*	*682*	*484*	*581*	*825*	*390*	*940*	*631*
DISCARDS	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***215***	***383***	***408***	***708***	***526***	***588***	***451***	***485***	***529***
BARBADOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12
CANADA	113	2314	2970	1885	561	554	1088	499	585	1059	954	898	1247	911	1026	1547	2234	1676	1610	739	1089	1115	1119
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	86	104	132	40	334	304
CHINESE TAIPEI	246	164	338	134	182	260	272	164	152	157	52	23	17	270	577	441	127	507	489	521	509	286	285
CUBA	398	281	128	278	227	254	410	206	162	636	910	832	87	47	23	27	16	50	86	7	7	7	7
EC-ESPAÑA	3309	3622	2582	3810	4014	4554	7100	6315	7441	9719	11135	9799	6648	6386	6633	6672	6598	6185	6953	5547	5140	4079	3993
EC-FRANCE	0	0	0	5	4	0	0	1	4	4	0	0	0	75	75	75	95	46	84	97	164	110	104
EC-IRELAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	132	81
EC-ITALY	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC-MARINIQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC-PORTUGAL	38	17	29	15	13	11	9	14	22	468	994	617	300	475	773	542	1961	1599	1617	1703	903	773	777
EC-U.K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	5	11	11	11
GRENADA	0	0	0	0	0	0	0	0	0	0	0	56	5	1	2	3	13	0	1	4	15	15	42
ICELAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
JAPAN	793	946	542	1167	1315	1755	537	665	921	807	413	621	1572	1051	992	1064	1126	933	1043	1494	1405	1566	1525
KOREA	541	634	303	284	136	198	53	32	160	68	60	30	320	51	3	3	19	16	16	19	15	0	0
LIBERIA	0	0	0	5	38	34	53	0	24	16	30	19	35	3	0	7	14	26	28	28	28	28	28
MAROC	7	11	208	136	124	91	129	81	137	181	197	196	222	91	110	69	39	36	79	462	267	191	119
MEXICO	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	14	0	0	14	28	24
NEI-1	0	0	0	0	0	0	0	0	0	0	0	76	112	529	0	0	0	0	0	0	0	0	0
NEI-2	0	0	0	0	12	0	0	0	0	14	3	131	190	185	43	35	111	0	0	0	0	0	0
NORWAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PANAMA	22	76	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
POLAND	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUMANIA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SENEGAL	0	0	0	0	0	0	0	0	0	0	0	0	1	0	6	6	0	0	0	0	0	0	0
ST.LUCIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
ST.VINCENT	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	23	0	4	3	1	1	1
TRINIDAD & TOBAGO	0	0	0	0	0	0	21	26	6	45	151	42	79	66	71	562	125	0	0	43	14	15	15
U.S.A	912	3684	4619	5625	4530	5410	4820	4749	4705	5210	5247	6171	6411	5519	4310	3852	3782	3366	4026	3559	2986	3058	2908
U.S.S.R	15	23	10	21	0	69	0	16	13	18	4	0	0	0	0	0	0	0	0	0	0	0	0
UK-BERMUDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	9	3
VENEZUELA	15	46	182	192	24	25	35	23	51	84	86	2	4	9	78	103	73	69	54	85	11	7	9
DISCARDS																							
CANADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	52	35
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	215	383	408	708	526	588	446	433	494

Shaded cells show estimated catches. In some cases, the Committee assumed the catch to be the same as the latest data available.

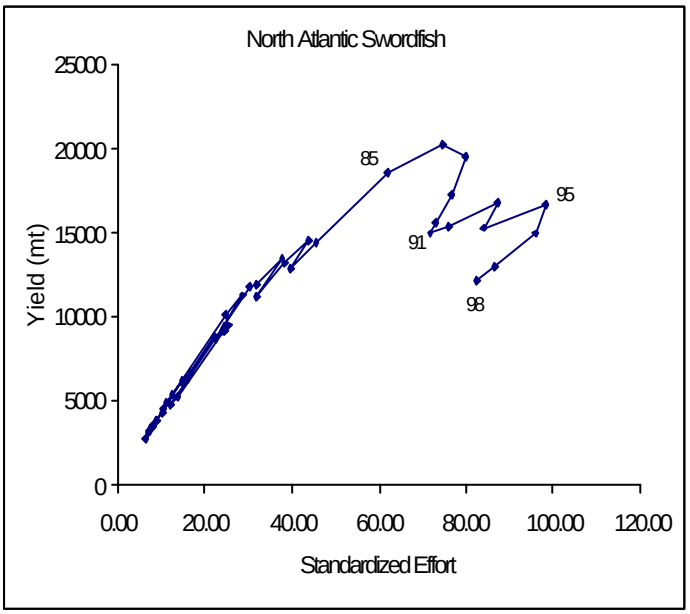
SWO-ATL-Table 1. Estimated catches(reported and carried over, in MT) of Atlantic swordfish by region, gear, flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
S. ATL (LAND + DISC)	**2855**	**2766**	**3294**	**5323**	**3975**	**6447**	**5402**	**9139**	**9586**	**5894**	**6030**	**12957**	**16925**	**17214**	**13878**	**13801**	**16045**	**19791**	**21887**	**18128**	**18381**	**13526**	**15463**
LANDINGS	***2855***	***2766***	***3294***	***5323***	***3975***	***6447***	***5402***	***9139***	***9586***	***5894***	***6030***	***12957***	***16925***	***17214***	***13878***	***13801***	***16045***	***19791***	***21887***	***18127***	***18360***	***13516***	***15457***
LONGLINE	*2840*	*2749*	*3265*	*5179*	*3938*	*6344*	*5307*	*8920*	*8863*	*4951*	*5446*	*12404*	*16398*	*16705*	*13287*	*13173*	*15547*	*17365*	*20806*	*17799*	*18114*	*13366*	*14941*
OTHER GEARS	*15*	*17*	*29*	*144*	*37*	*103*	*95*	*219*	*723*	*943*	*584*	*553*	*527*	*509*	*591*	*628*	*498*	*2426*	*1081*	*328*	*246*	*150*	*516*
DISCARDS	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***1***	***21***	***10***	***6***
ANGOLA	0	0	0	0	0	0	0	26	228	815	84	84	84	0	0	0	0	0	0	0	0	0	0
ARGENTINA	132	4	0	0	0	20	0	0	361	31	351	198	175	230	88	88	14	24	0	0	0	0	0
BELIZE.SH.OB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	17
BENIN	0	0	0	0	18	24	0	86	90	39	13	19	26	28	28	26	28	25	24	24	24	24	24
BRASIL	396	372	521	1582	655	1019	781	468	562	753	947	1162	1168	1696	1312	2609	2013	1571	1975	1892	4100	3847	4720
BULGARIA	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMB.OB.SH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
CHINA.PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	534
CHINESE TAIPEI	675	625	1292	702	528	520	261	199	280	216	338	798	610	900	1453	1686	846	2829	2876	2873	2562	1147	1168
COTE D'IVOIRE	0	0	0	0	0	0	0	10	10	10	10	13	5	9	21	15	17	24	22	30	21	17	30
CUBA	302	319	272	316	147	432	818	1161	1301	95	173	159	830	448	209	246	192	452	778	60	60	0	0
EC-ESPAÑA	0	0	0	0	0	0	0	0	0	66	0	4393	7725	6166	5760	5651	6974	7937	11290	9622	8461	5832	5758
EC-PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	380	389	441	384	381
G.EQUAT(OB.SH)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
GHANA	0	0	0	110	5	55	5	15	25	13	123	235	235	235	235	235	235	235	235	140	140	106	106
HONDURAS-OB.SH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	5	2	8
JAPAN	514	503	782	2029	2170	3287	1908	4395	4613	2913	2620	4453	4019	6708	4459	2870	5256	4699	3619	2197	1355	985	810
KOREA	699	699	303	399	311	486	409	625	917	369	666	1012	776	50	147	147	198	164	164	7	18	7	0
LITUANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	794	0	0	0	0	0
NAMIBIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	730
NEI-1	0	0	0	0	0	0	0	0	0	0	0	0	856	439	0	0	0	0	0	0	0	0	0
NIGERIA	0	0	0	0	0	0	83	69	0	0	0	0	0	0	0	3	0	857	0	9	0	0	0
PANAMA	28	83	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105
SAO TOME & PRINCIPI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	14
SOUTH AFRICA	0	0	28	31	9	3	7	0	8	5	5	4	0	0	5	9	4	1	4	1	1	169	76
TOGO	0	0	0	0	0	0	0	0	6	32	1	0	2	3	5	5	8	14	14	64	0	0	0
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171	396	160	179
U.S.S.R	106	161	70	154	40	26	46	158	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
URUGUAY	0	0	0	0	92	575	1084	1927	1125	537	699	427	414	302	156	210	260	165	499	644	760	791	791
DISCARDS	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*21*	*10*	*6*
U.S.A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	21	10	6

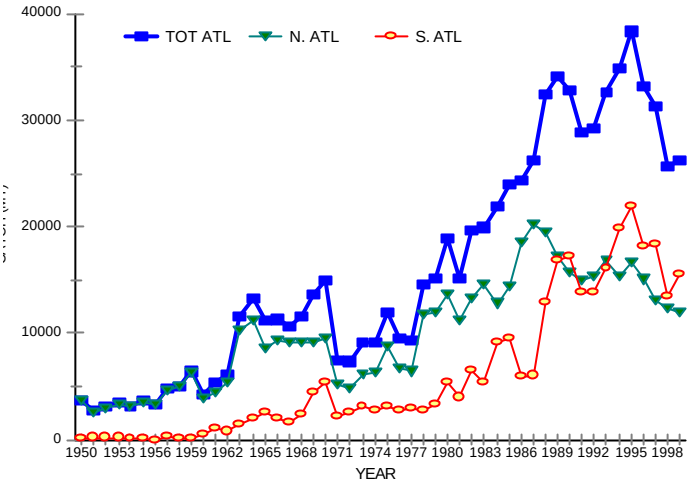
Shaded cells show estimated catches. In some cases, the Committee assumed the catch to be the same as the latest data available.



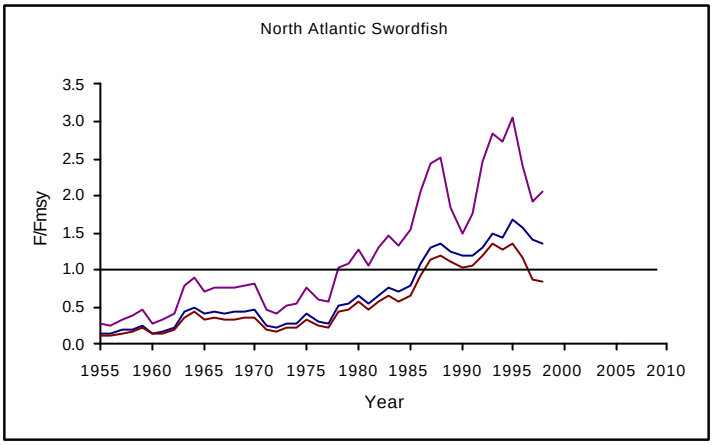
SWO-Atl-Fig. 1 . Geographical distribution of swordfish catches by longline in 1997. The dashed line at 5°is the assumed boundary between north and south management units.

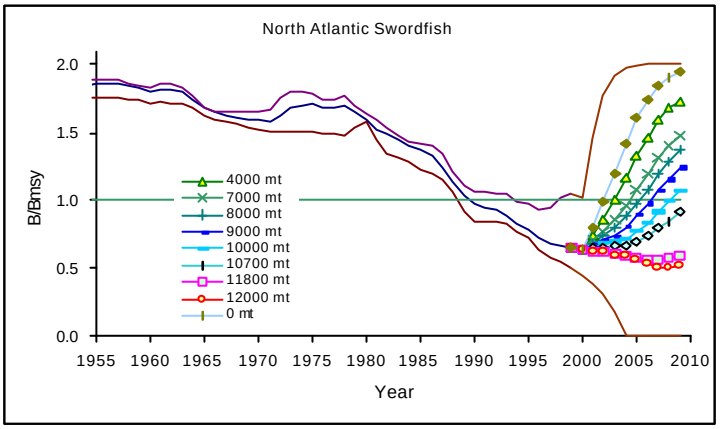


SWO-ATL-Fig. 3. Relationship between nominal catch and estimated standardized effort for the north Atlantic swordfish assessment. Selected years are indicated. (Figure from 1999 Report, and not updated in 2000.)

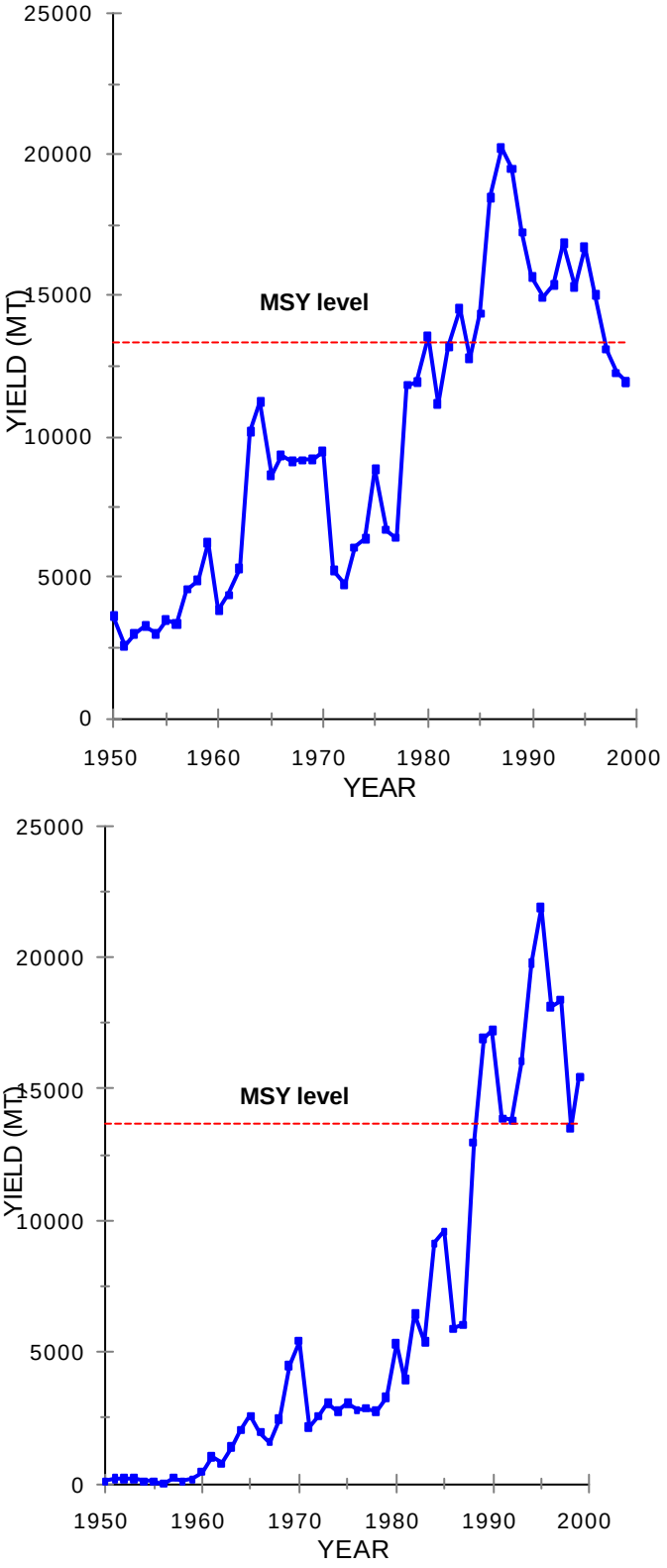


SWO-Atl-Fig. 2 Estimated catches (reported and carried over) of Atlantic swordfish (in MT, including discards).

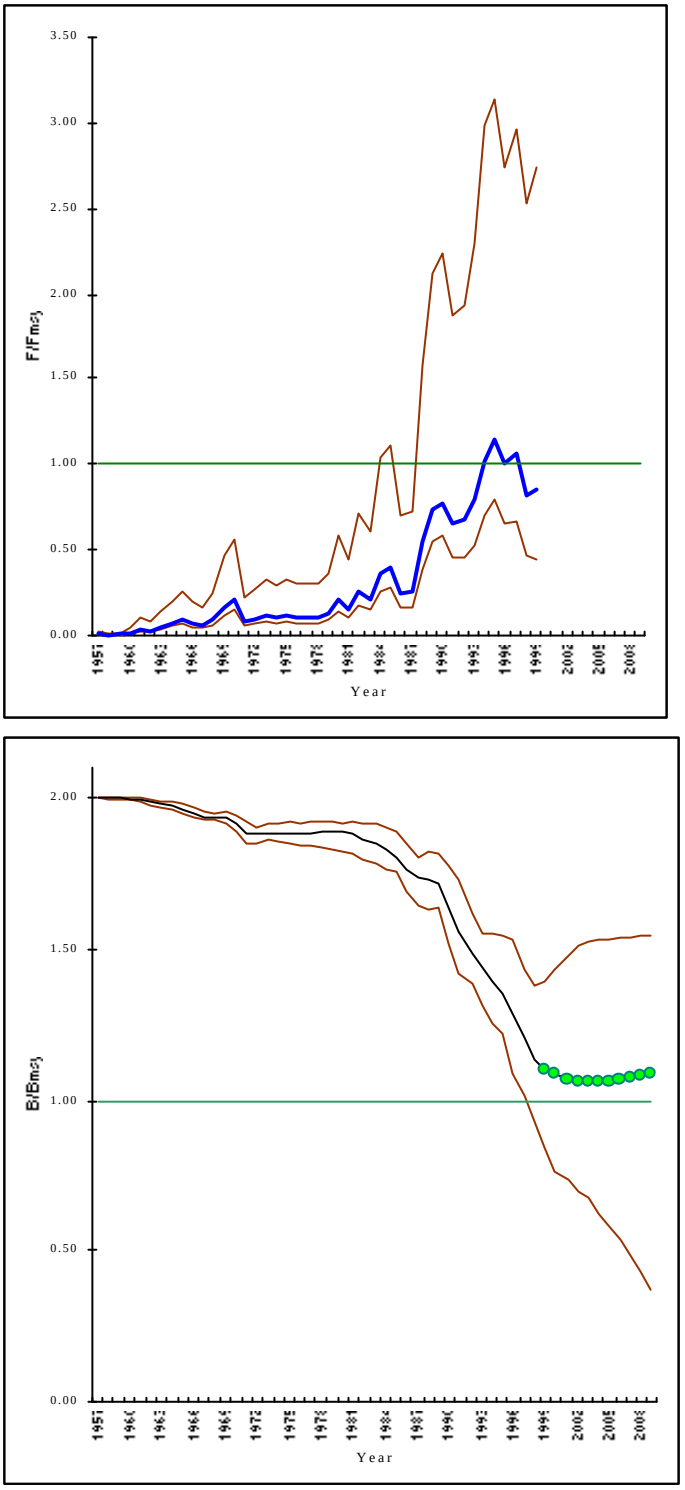




SWO-Atl-Fig.4. North Atlantic swordfish: Upper plate: Estimated fishing mortality rate relative to Fmsy (F/Fmsy) for the period 1955-1998 Upper line is upper 80% confidence bound, lower line is lower 80% confidence bound and center line is median from 700 bootstrap trials. Lower Plate: Estimated biomass relative to biomass at MSY (B/Bmsy) for the period 1955-1999 followed by 10 year projected B/Bmsy under the constant catch scenarios listed. Upper and lower lines represent approximate 80% confidence ranges. For the catch projection period (1999-2009), upper line is the upper 80% confidence bound for the 0 mt projection and lower line is the lower 80% confidence bound for the 12000 mt projection. (Figure from 1999 Report, and not updated in 2000.)



SWO-Atl-Fig. 5 **Upper plate: Annual yield (mt) for north Atlantic swordfish relative to estimated MSY level for the north Atlantic. Lower plate: Annual yield (mt) for south Atlantic swordfish relative to estimated MSY level for the south Atlantic.**



SWO-Atl-Fig. 6 **South Atlantic swordfish: Upper Plate: Estimated fishing mortality rate relative to Fmsy (F/Fmsy) for the period 1957-1998. Upper line represents upper 80% confidence bound, center line the median and lower line the lower 80% confidence bound from 700 bootstrap trials. Lower Plate: Estimated biomass relative to biomass at MSY (B/Bmsy) for the period 1957-1999 and projected with an assumed constant catch of 13,620 MT per year for the period 1999-2009. Upper line represents upper 80% confidence bound, center line the median and lower line the lower 80% confidence bound. (Figure from 1999 Report, and not updated in 2000.)**

SWO-MED – MEDITERRANEAN SWORDFISH

In September 2000, the Fifth Meeting of the GFCM/ICCAT Ad Hoc Working Group on Stocks of Large Pelagic Fishes in the Mediterranean Sea attempted to update the Mediterranean swordfish data base. The Committee continues to be concerned about the lack of data on catch, effort and size from some important fisheries in the Mediterranean. The absence of these data make it impossible to conduct reliable stock assessments. For the purposes of this Executive Summary, catches that were not reported were assumed to be equal to the reports for the previous year. In 1999, more than half of the estimated catch was not reported (see **SWO-MED-Table 1**).

SWO-MED-1. Biology

Swordfish is a cosmopolitan species found in the Atlantic Ocean and the Mediterranean Sea. Several recent genetic studies suggest that Mediterranean swordfish form a unique stock which is reproductively isolated from the Atlantic stocks. Several fisheries and biological studies suggest that there is limited movement from the Mediterranean to areas immediately adjacent in the North Atlantic. Genetic studies have confirmed this pattern.

Swordfish feed mainly in the meso-pelagic zone and its prey is comprised mostly of cephalopods and pelagic fish species. Spawning occurs in the Strait of Messina and the Tyrrhenian Sea and around the Balearic Islands and probably in other locations. It has been described that in the Mediterranean, swordfish spawn during the summer months and young swordfish grow very rapidly, reaching more than 80 cm by the end of their first year of life. Females grow faster than males and reach a larger maximum size. Female swordfish reach sexual maturity in their third year of life at a length of about 130 cm, while males mature one year earlier ; this is substantially younger than the age of maturity assumed for the Atlantic stocks (age 5).

SWO-MED-2. Description of fisheries

Mediterranean swordfish fisheries are characterized by high catch levels. It should be noted that average annual reported catches (about 13,400 MT for the past 10 years) are similar to those of the North Atlantic. The Mediterranean is a much smaller body of water compared to the North Atlantic. However, the potential reproductive area in the Mediterranean is probably relatively larger than that in the Atlantic. Further, the productivity of the Mediterranean Sea is thought to be very high.

Swordfish fishing has been carried out in the Mediterranean using harpoons and driftnets at least since Roman times. Mediterranean total swordfish landings showed an upward trend from 1965-72, stabilized between 1973-1977, and then resumed an upward trend reaching a peak in 1988 (20,339 MT) **(SWO-MED-Table 1, SWO-MED-Figure 1)**. The sharp increase between 1983 and 1988 may be partially attributed to improvement in the national systems for collecting catch statistics. Since 1988, the reported landings of swordfish in the Mediterranean Sea have declined and since 1990, they have fluctuated from about 12,000 to 16,000 MT. There has been a sharp decline in *reported* swordfish catch in the recent two years, largely due to the lack of reporting from Italy, so that the actual level of catch in 1998 and 1999 is highly uncertain.

Swordfish fishing is carried out all over the Mediterranean Sea. The biggest producers of swordfish in the Mediterranean Sea in the recent years were Italy (43%), Morocco (33%), and Spain (7%). Also, Algeria, Cyprus, Greece, Malta, Tunisia, and Turkey have fisheries targeting swordfish in the Mediterranean. Incidental catches of swordfish have also been reported by Croatia, France, Japan and Libya.

At present, mainly surface longlines and driftnets are used for fishing. Most of the above-mentioned countries operate longline fisheries, and large-scale driftnet fisheries are mostly limited to Italy (3632 MT in 1997) and Morocco (2979 MT in 1999). Swordfish are also caught with harpoons, purse seines and traps, but the latter two gears are not used for targeting swordfish.

There is a high demand for swordfish for fresh consumption in most Mediterranean countries.

SWO-MED-3. State of stock

The Committee is concerned about the high catches of juvenile swordfish (those which have never spawned) in the Mediterranean, the apparent scarcity of large fish in the catch, and high uncertainty in estimates of high annual recruitments. Even without the aid of a robust analytical assessment, there are obvious warning signs from the Mediterranean fishery which warrant concern. The fact that the fishery is based on 2-3 young year-classes **(SWO-MED-Figure 2)** makes it vulnerable to recruitment changes. Furthermore, compared to the North Atlantic swordfish stock, the age of maturity is substantially less and fish have a smaller size at age in the Mediterranean, either suggesting possible biological compensation for heavy mortality and/or the influence of different environmental conditions in the Mediterranean. The VPA conducted in 1995 was not updated in 1998 partly because of a lack of sufficient improvements to input data, and partly due to time constraints. The results of the 1995 analysis were highly uncertain owing to uncertainty in the biological parameters, catch (1990-1996 since revised upwards substantially), and standardized CPUE used in tuning the analysis. As such, there was uncertainty about the veracity of the estimated trends in abundance, exacerbated by a lack of knowledge of current stock sizes relative to an unfished condition.

SWO-MED-4. Outlook

Given the absence of a substantial portion of recent data (catch, effort and size), the short time series of reliable data and the long history of exploitation in the Mediterranean, it is uncertain where the Mediterranean stock is in relation to unexploited stock levels. The unknown status of the stock, the very large and uncertain catch of very small fish, and warning signs from the fishery are cause for concern.

SWO-MED-5. Effects of current regulations

Although ICCAT has no specific regulatory measures for Mediterranean swordfish fisheries, several countries do. The EC Mediterranean Member States are enforcing the regulations adopted by the EC to this effect and particularly the minimum size of 120 cm LJFL (with no tolerance). More restrictive measures were adopted by some of these countries at the national level, such as the ban of driftnet use in the Ligurian Sea; the implementation of a closed season (1 October-30 January) by Greece; the setup of a special licensing system for bluefin and swordfish fishing. Spain adopted a limit to the number and size of hooks for longline (2000 hooks). Non-EC Member Countries are enforcing the GFCM regulation of relevance to large pelagic fisheries, particularly the maximum size of driftnets to 2.5 km. Some non-EC Member Countries, such as Croatia and Turkey, apply the minimum size of 120 cm LJFL. Additional national regulations are described in SCRS/98/11-bis.

The Committee reviewed the various measures taken by member countries and noted the difficulties in implementing some of the management measures, particularly that of minimum size. This minimum size regulation may not be practical in all situations given that 64% of the Mediterranean catches of swordfish in 1994 were less than 120 cm. Alternate and complementary measures are suggested in the Report of the Fourth Meeting of the Ad Hoc GFCM/ICCAT Joint Working Group (Genoa 1998).

SWO-MED-6. Management recommendations

Consistent with the Precautionary Approach and if managers want to be assured of maintaining the Mediterranean stock of swordfish, then the Committee strongly recommends reducing the fishing pressure on juvenile swordfish in order to improve yield per recruit and spawning biomass per recruit. In addition, given the uncertainty of the location of the boundary between the Mediterranean and North Atlantic stocks, it is important to identify the biological origin of those catches reported at or near the boundary so that the resulting knowledge can be considered in the management of the North Atlantic and/or Mediterranean stocks.

The Committee continues to recommend that the Commission ensure that reliable data be provided on catch, effort and size for Mediterranean swordfish. Improvements to these basic inputs to the stock assessment are essential before an improved assessment of Mediterranean swordfish can be achieved.

MEDITERRANEAN SWORDFISH SUMMARY

Maximum Sustainable Yield	not estimated
Current (1999) Yield	incomplete *
Replacement Yield	not estimated
Relative Biomass (B_{1994}/B_{MSY})	not estimated[1]
Relative Fishing Mortality:	
F_{1994}/F_{MSY}	not estimated[1]
F_{1994}/F_{max}	~ 1.1 (0.9-1.4)[2]
$F_{1994}/F_{0.1}$	~ 1.9 (1.5-2.4)[2]
Relative Recruitment	not estimated[1]
Management Measures in Effect	No ICCAT regulations; National and European Union minimum size and effort controls

* For the purposes of this Executive Summary, catches that were not reported were assumed to be equal to the reports for the previous year. In 1999, more than half of the estimated catch was not reported (see **SWO-MED-Table 1**).

[1] Results suggest that it is unlikely that the Mediterranean stock can sustain continued high catches of juveniles without high recruitment. The odds of continued high recruitment diminish as mature fish are removed from the population.

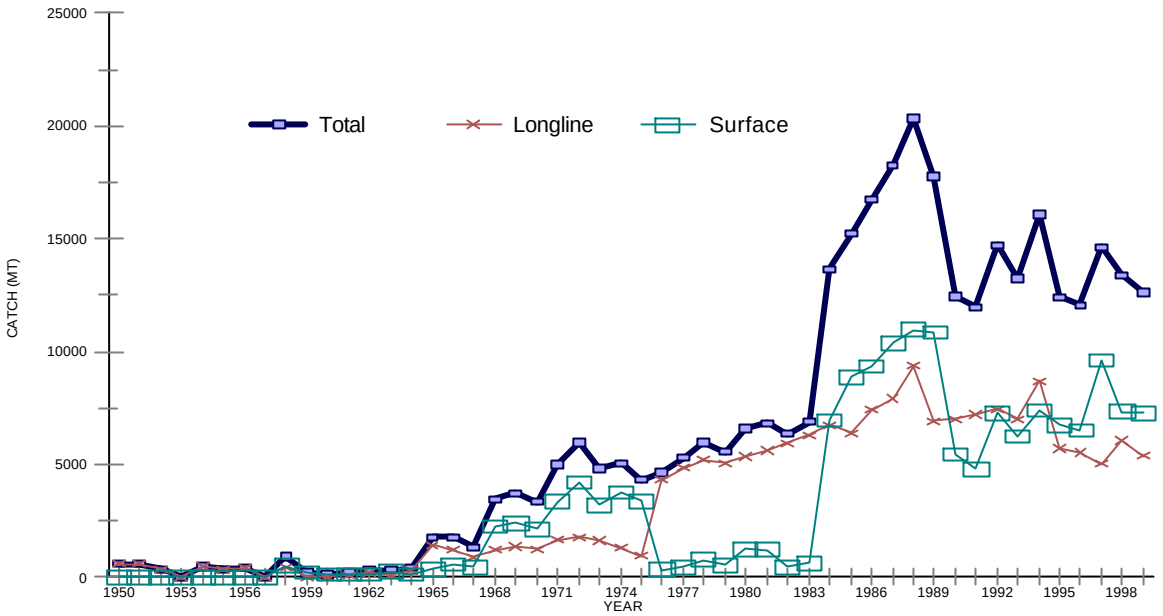
[2] Based on stock size weighted average F's for age 2 and 3 fish in 1993 from VPA analysis conducted in 1995. Approximate 80% CI based on estimated CV(F) = 0.2.

~ = approximate value.

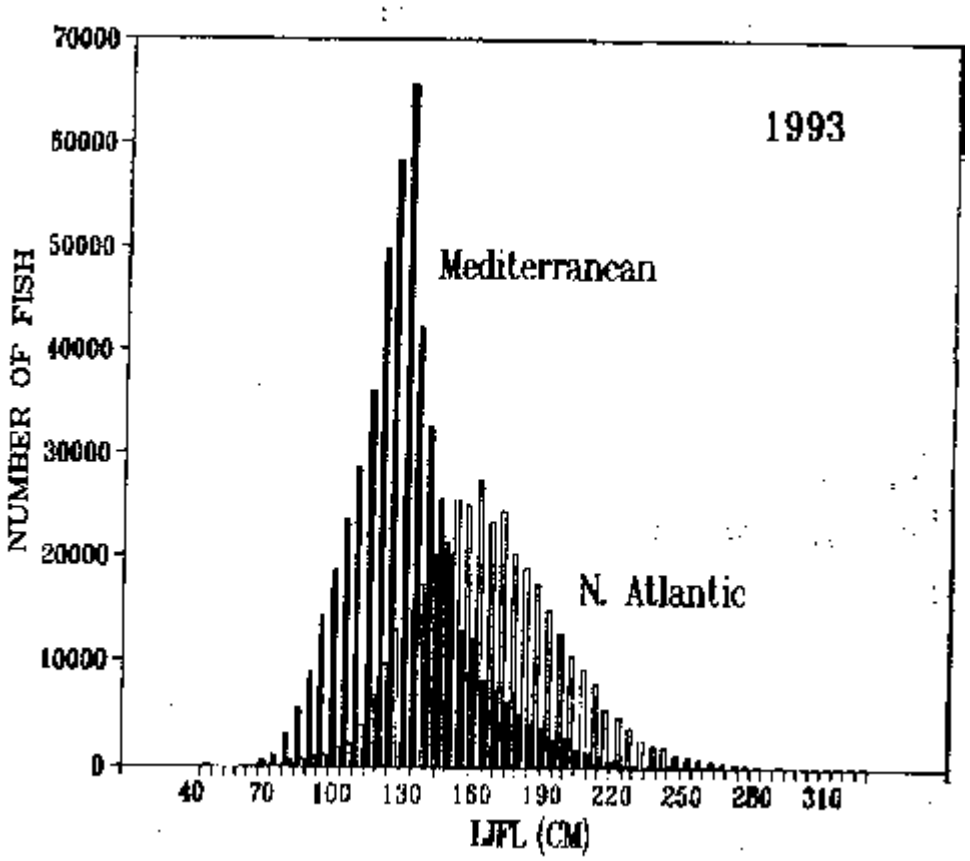
SWO-MED-Table 1. Estimated catches(reported and carried over, in MT) of Mediterranean swordfish by gear and flag.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
MEDITERRANEAN	**5280**	**5958**	**5547**	**6579**	**6813**	**6343**	**6896**	**13666**	**15226**	**16718**	**18288**	**20339**	**17761**	**12428**	**11987**	**14712**	**13250**	**16077**	**12414**	**12039**	**14645**	**13377**	**12626**
LONGLINE	*4829*	*5182*	*5028*	*5337*	*5603*	*5928*	*6298*	*6734*	*6368*	*7394*	*7912*	*9370*	*6905*	*6995*	*7202*	*7456*	*7008*	*8682*	*5692*	*5518*	*5025*	*6045*	*5358*
OTHER AND UNCL	*451*	*776*	*519*	*1242*	*1210*	*415*	*598*	*6932*	*8858*	*9324*	*10376*	*10969*	*10856*	*5433*	*4785*	*7256*	*6242*	*7395*	*6722*	*6521*	*9620*	*7332*	*7268*
ALBANIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	13	13
ALGERIE	370	320	521	650	760	870	877	884	890	847	1820	2621	590	712	562	395	562	600	807	807	807	0	0
CHINESE TAIPEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	3	0	0
CROATIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	20
CYPRUS	95	82	98	72	78	103	28	63	71	154	84	121	139	173	162	73	116	159	89	40	51	61	92
EC-ESPAÑA	667	720	800	750	1120	900	1322	1245	1225	1337	1134	1762	1337	1523	1171	822	1358	1503	1379	1186	1264	1443	905
EC-FRANCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EC-GREECE	0	0	0	0	91	773	772	1081	1036	1714	1303	1008	1120	1344	1904	1456	1568	2520	974	1237	750	1650	1520
EC-ITALY	3747	4506	3930	4143	3823	2939	3026	9360	10863	11413	12325	13010	13009	5524	4789	7595	6330	7765	6725	5286	6104	6104	6104
JAPAN	0	2	3	1	0	5	6	19	14	7	3	4	1	2	1	2	4	2	4	5	4	7	6
LIBYA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
MALTA	223	136	151	222	192	177	59	94	108	97	131	207	121	122	119	71	76	42	58	58	83	116	147
MAROC	144	172	0	0	0	0	43	39	38	92	40	62	97	1249	1706	2692	2589	2654	1696	2734	4900	3228	3238
NEI-2	0	0	0	728	672	517	532	771	730	767	828	875	979	1360	1292	1292	0	0	0	0	0	0	0
TUNISIE	0	0	0	0	7	19	15	15	61	64	63	80	159	176	181	178	354	298	378	352	346	414	468
TURKEY	34	20	44	13	70	40	216	95	190	226	557	589	209	243	100	136	292	533	304	320	320	320	113

Shaded cells show estimated catches. In some cases, the Committee assumed the catch to be the same as the latest data available.



SWO-MED-Fig. 1. **Estimated catches (reported and carried over, in MT) of Mediterranean swordfish.**



SWO-MED-Fig. 2. **Comparison of 1993 size distributions of swordfish catches in the Mediterranean and north Atlantic. It should be noted that the biological parameters (e.g. growth rate, size of maturity, etc.) are different between these areas (see Sections SWO-MED-1 and SWO-ATL-1) . (Figure from 1999 Report, and not updated in 2000.)**